(Original English Translation)

REAR-VIEW MIRROR FOR VEHICLES

The invention relates to a rear-view mirror for vehicles, preferably motor vehicles, according to the preamble of claim 1.

In inner rear-view mirrors of motor vehicles, the mirror housing is provided with two sensors, of which one sensor detects the glare light originating from the following motor vehicle and the other sensor detects the ambient light. Both the sensors require expensive an control system in order to darken the EC mirror glass corresponding to the intensity of the glare light as a function of the ambient light.

The object underlying the invention is to embody a rear-view mirror of this type in such a way that its EC mirror glass can be reliably darkened easily.

This object is achieved in a rear-view mirror of the generic type according to the invention using the characterizing features of claim 1.

As a result of the inventive embodiment, the light flux is fed to the sensor by the light guide. The sensor can be arranged at any suitable location in the rear-view mirror. Using the light guide, the light can be reliably fed to the sensor, which converts the light flux into an electrical signal. Said electrical signal is consulted for darkening the EC mirror glass.

In the solution according to claim 1, the ambient light detected by the additional light guide is also fed to the sensor. The sensor can then optimally darken the EC mirror glass taking into account the ambient light.

If the glare light and the ambient light are guided to the sensor using the two light guides, the light flux of one light guide is preferably interrupted periodically. Thus a combined

light flux consisting of glare light and ambient light and a glare light flux or an ambient light flux is fed to the sensor in an alternating manner. The sensor can thus easily determine the intensity of the glare light and that of the ambient light and darken the EC mirror glass optimally taking into account the glare light and the ambient light. Since only a single sensor is provided, the expenses related to the circuitry can be kept low.

The rear-view mirror can be an inner rear view mirror and/or an outer rear view mirror of a motor vehicle. In or on the housing of this rear view mirror, additional components can be provided, such as a heating system for the mirror glass, an antenna, loudspeakers, illuminants for reading light and/or ambient light, a compass, a display device, a repetitive flashing light and the like. These components can be provided in any combination.

Additional characteristics of the invention are specified in the additional claims, the description and the drawings. In the following the invention is described in more detail on the basis of several embodiments illustrated in the drawings, of which:

Fig. 1	illustrates a view of an inventive rear-view mirror of a motor vehicle, said rear-view mirror having a sensor,
Fig. 2	illustrates schematically a switching device of the rear-view mirror shown in fig. 1,
Fig. 3 and fig. 4	each illustrate an additional switching device in an illustration shown in fig. 2,
Fig. 5a to 5c	each schematically illustrate different embodiments of optical switches of the switching device,
Fig. 6	schematically illustrates sensor voltages in case of different light sources,
Fig. 7	schematically illustrates the measuring principle of the switching device.

Fig. 1 illustrates an inner rear-view mirror 1 of a motor vehicle, said rear view mirror having a housing 2, in the opening of which an EC mirror glass 3 is arranged. In order to prevent the driver from getting blinded by the light of a following vehicle falling on the mirror glass 3, a sensor 7 is accommodated in the mirror housing 2 and/or the frame 3 surrounding the EC mirror glass 3. Said sensor emits a switching signal upon the incidence of glare light, using which signal the mirror glass 3 is darkened in the known manner so that the driver is not blinded. The sensor 7 can naturally also be accommodated on any other location in the mirror housing or even in the vehicle interior.

The sensor 7 is a photosensor, which converts the light flux fed to it into an electrical signal, which is consulted for controlling the EC mirror glass 3. The sensor 7 is a part of a switching device 20, which comprises two light guides 8, 8', which merge into one another in the area in front of the sensor 7. A light emission surface 14 of the merged light guides 8, 8' lies opposite to the sensor 7. The light guides 8, 8' are arranged in such a way that their light entrance surface 15, 16 is directed toward the back and toward the front in the direction of travel of the vehicle. The glare light 4 of the following vehicle falls on the entrance surface 15, which is directed towards the back, while the entrance surface 16 directed towards the front detects the ambient light 5. The light is fed by both the light guides 8, 8' to the sensor 7. Depending on the level of the light flux the mirror glass 3 can be darkened to a greater or lesser extent.

In order for the sensor 7 to be able to separate the glare light and the ambient light 4, 5 from one another, an optical switch 9 is arranged in the area in front of the light entrance surface 16 of the light guide 8'. Using said optical switch 9 the light entrance surface 16 can be covered preferably periodically. Thus the sensor 7 once receives the light flux fed by both the light guides 8, 8' and once only the light flux fed by the light guide 8. The sensor 7 thus can generate an electrical signal depending on the glare light 4 taking into account the ambient light 5 in order to darken the EC mirror glass 3 accordingly.

The optical switch 9 can be embodied in the known manner as a mechanical system, such as apertures, displaceable grids, rotating mirrors or the like. However, it can

also be embodied as an LCD element as used in the form of displays. The switch 9 can additionally be a shutter, which is based on ferroelectric liquid crystals (FLC).

Fig. 3 illustrates a switching device 20, in which both the light guides 8, 8' are guided separate from one another up to the sensor 7. In contrast to the embodiment shown in fig. 2, the optical switch 9 is not arranged in front of the light guide 8', instead between it and the sensor 7. Using the optical switch 9, the ambient light 5 fed using the light guide 8' is allows to pass through to or screened off from the sensor 7. The sensor 7 thus receives the light flux fed by both the light guides 8,8' or only the glare light 4 using the light guide 8. Accordingly the sensor 7 generates an electrical signal, which is consulted for darkening the EC mirror glass 3.

In the embodiment illustrated in fig. 4, both the light guides 8, 8' are brought up to the vicinity of the sensor 7 separate from one another. An optical switch 9 is located in each case in front of the light entrance surface 15 of the light guide 8 and between the light emission surface 10 of the light guide 8' and the sensor 7. Both the switches 9 are controlled in an alternating manner in such a way that the sensor 7 receives light only from the light guide 8 or only from the light guide 8'. The sensor 7 can accordingly darken the EC mirror glass as a function of the glare light 4 taking into account the ambient light 5.

Naturally, as in embodiment illustrated in fig. 2 a third optical switch can also be provided in front of the light entrance surface 16 of the light guide 8'.

Even other combinations of optical switches 9 are feasible. Thus for example, they can be also provided inside the light guides 8, 8' or between the light emission end 10, 11 of the light guides 8, 8' and the sensor 7.

The optical switches 9 of each switching device 20 can be different. However, it is advantageous if the switches 9 of the switching device are similar.

In the described embodiments the optical switches 9 are each controlled in the described manner in such a way that the light is guided by the light guides 8, 8' to the sensor 7 or the light flux is interrupted. Should the light flux be interrupted on only one light guide (Fig. 2 and 3), the determination of the brightness of the light source is carried out by addition and/or subtraction of the sensor signal when the optical switch 9 is switched on/off. On the contrary, if separate optical switches 9 are used on both the light guides 8, 8' (fig. 4), the brightness of both the light sources 4, 5 can be determined by an alternating toggle of the optical switches 9.

The switching frequency and accordingly the evaluation frequency is adjusted to the application case. Thus in an EC mirror glass a switching frequency of > 5 Hz is practical in order to be able to detect and evaluate a change in the ambience quickly enough. In principle, the upper limit of the switching frequency can be set randomly. A low frequency cycle time is sufficient for the application case in inner rear view mirrors.

Fig. 6 illustrates basically the voltage curve of the sensor 7 in case of incident light. The upper curve 27 is decisive for the ambient light, the lower curve 28 for the glare light 4. In case of two sensors 7 the sensor voltages would run in a comparable manner.

Fig 7 basically illustrates the gradient of the sensor signal in case of a clocked sensor. The black line (bold, dashed) shows the sensor signal, if the optical switch 9 in one cycle guides both the light sources 4, 5 to the sensor 7 and if in the next cycle only one of the two light sources 4, 5 is guided to the sensor 7. By taking the difference using the signal from the preceding cycle, the brightness of the individual light sources 4, 5 can be calculated. In case of a high clock speed, the error is small, if the fluctuations of the light source take place slowly in comparison to the clock speed. If for example, in case of an even cycle the light of both the light sources 4, 5 is fed to the sensor 7 and in an odd cycle, only the light of the light source 4 is fed to the sensor, then the result is the brightness of the light source 5 according to the equation:

$$\text{even cycle} - \text{odd cycle} = \text{light source } 5.$$

In case of an LCD element, as an optical switch 9, it is possible to use reflective, transflective or transmissive LCD's per se. In the previously described embodiments illustrated in fig. 2 to 4, the use of transmissive LCD's is advantageous. However, reflective LCD's are also suitable for the switches.

If a shutter is used as an optical switch 9, said shutter advantageously consists of three layers, and filters which are rotated by 90°, which polarize the light and between which an LC medium is provided as a third filter. By the electrical control of the LC medium, the light can again be rotated by 0° to 90°. The shutter can thus allow the light to pass through or can block the light passage. Due to the polarization filter the maximum transmission is approximately 50%.

The fig. 5a to 5c schematically illustrate different embodiments of an LCD element. The optical switch 9 in the form of an LCD element shown in fig. 5 is embodied as a transflective LCD element. The light 21 of a light source falls from the observer's side (indicated by an eye) on the LCD element. The arrow 22 indicates the reflected light directed against the observer. The light 23 of a rear light source falls on the other side of the LCD element. The reflected light is marked with the arrow 24. The LCD element 9 additionally has a reflector 25 on its rear side.

Fig. 5b schematically illustrates a reflective LCD element. The light 21 falling from the observer's side on this LCD element 9 is reflected toward the observer (arrow 22).

Fig. 5 finally schematically illustrates a transmissive LCD element 9. The light 23 falling from the rear side on the LCD element passes through the LCD element 9 and emerges again as the transmitted light 26 on the observer's side.

Using the described arrangements the brightness of the ambient light and the glare light 5 and 4 respectively can be easily determined using only a single sensor 7 and thus an optimal darkening of the mirror glass 3 is achieved in an easy manner from the point of view of design.